

# STA Water Quality Monitoring

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# Background

## Funding considerations

- Annual STA revenues decreased 2007 - 2013
- Monitoring costs increased with STA expansions

## Operational considerations

- Weekly operational decisions based on inflows to STAs and outflows of flow ways
- Mid levee TP concentrations-typically do not result in managers making operational changes

## Conclusions

- STA inflows and flow way outflows most critical to assess and manage performance
- Sampling of flow way inflows could be augmented with STA inflow data
- Mid levee data sampling could be reduced and replaced by synoptic transect studies and Science Plan efforts
- Opportunities to reduce STA monitoring costs exist

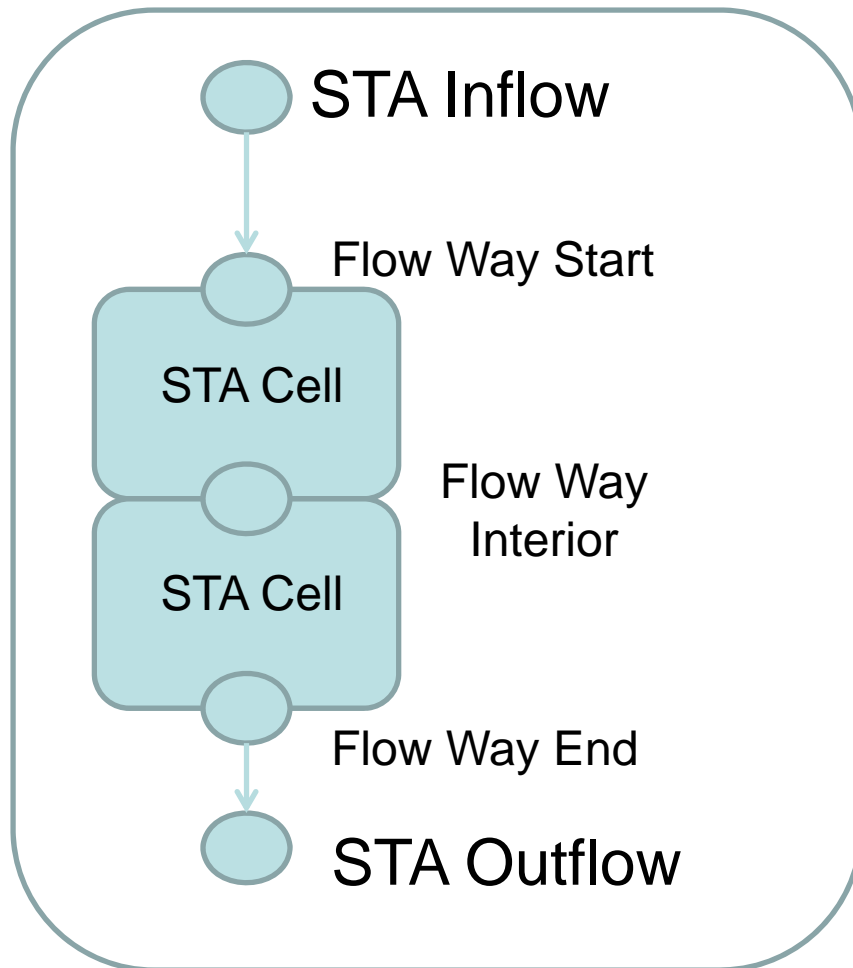
# Objectives of STA Monitoring

- Supply data to comply with mandates
  - State and federal permits, the Settlement Agreement and the EAA/C139 rule
- Supply data for STA management
  - Operation and optimization
- Provide core monitoring network
  - Leverage and modify as needed to support the STA Science Plan

# Monitoring Network Design Process

- Re-design of STA monitoring began in 2010
  - Design delayed by permit development, but eventually incorporated permit requirements
- An overarching re-design strategy applicable to all STAs was preferred over an STA specific approach
- Monitoring Plan vetted through District staff and management and FDEP
- Transitioned to new strategy from October 2012 to January 2013

# STA Design Concepts



STA designs are all variations of a common theme

District staff used this concept to develop guidance for monitoring STAs

# Use of Autosamplers

- Autosamplers are required by permit at the STA Inflows and Outflows
  - Infrastructure at these locations can support autosamplers
- Autosampler Limitations
  - Can only measure TP, TKN, TOC
  - Do not effectively sample low or no flow events
  - Must be visited weekly, but on average supply fewer than 26 data points per year
- Unexplained Variability is a Fundamental Issue
  - Remote Phosphorus Analyzer (RPA) data suggests strong correlations with both grab and autosampler data, with autosampler data slightly higher than the other two, but the difference is not likely to impact operational decisions (Science Plan Project)
  - Given these issues, the cost-benefit analysis for autosamplers does not favor their usage at non-compliance stations

# Monitoring Inflows and Starts

- Monitoring of STA Inflows is mandated as weekly
- Starts dependent on Inflows
  - Distance from Inflows to Flow Way Starts is often relatively short (or non-existent); Starts should reflect conditions at the Inflows
  - There are 16 Inflows and 38 Starts with only 4 overlaps, to upgrade all Starts to Inflow equivalents would increase monitoring in this category three-fold
- STA Inflows should be key sampling points
  - Reduce monitoring at Starts
  - Leverage data at Inflows
  - Supplement autosampler data with recorded flow grabs which collect during low flow events but limit responsibility during no flow periods
  - Allow for flexibility when bringing flow ways on line, or during research

# Monitoring Outflows and Ends

- Monitoring of STA Outflows is mandated weekly
- Outflows dependent on Ends
  - The distance between Outflows and Flow Way Ends is often relatively short (or non-existent), in essence Outflows should be driven by the Ends
  - There are approximately 23 Flow ways
    - 11 flow ways have Ends that function as independent Outflows (STA3/4 and 5/6)
    - 9 flow ways Ends are subordinate to one of three Outflows (STA1E, STA2)
    - STA1W has three flow ways and two outflows
- Flow way Ends should be key sampling points
  - Intensely monitor at Ends
  - Leverage data at Outflows to supply parameter data back to Ends
  - Supplement autosampler data with recorded flow grabs which collect during low flow events but limit responsibility during no flow periods
  - Allow for flexibility when bringing flow ways on line, or during research



# Monitoring Interiors

- A decision was made to focus on **STA Flow Ways rather than cells**
  - This emphasis is the foundation of planning
  - Mid levee sample data not representative of marsh during stagnant periods
  - Three EAV to SAV flow ways have no mid levees
  - Many designated “EAV” or “SAV” cells contain mix of EAV and SAV
- This strategy minimizes the need for monitoring at STA interiors
  - Avoids significant technical problems and costs
  - Long-term data on Flow Ways and STAs will provide information for performance evaluation

# Parameters

- The permits require monitoring of TP and other parameters at the Inflows and Outflows
- While TP is the compliance standard, other parameters are of interest and have been added to the routine monitoring through grab sampling
  - Ca to support modeling and periphyton research
  - DOC to support carbon cycling research
  - TDPO<sub>4</sub> and OPO<sub>4</sub> to support phosphorus speciation
- Additional parameters leverage intensive monitoring at Inflows and Ends






# Seepage Measurements

- Seepage return data not used in historical or proposed future STA inflow compliance reporting
  - Seepage return flows are small components of STA water budgets
  - Historical seepage data available and stable
- Some seepage monitoring remains active
  - STA-1E seepage return is still monitored at S361 (also an STA inflow compliance point)
  - Seepage return at STA-5/6 (G349A) still monitored




# Summary

- Inflow, Outflow, and End sampling is weekly
  - Consistent with historical sampling frequency
- Starts are biweekly, but can be supplemented with data from Inflows, and routinely verified.
- Interiors are monthly, but the flow way is the managed unit

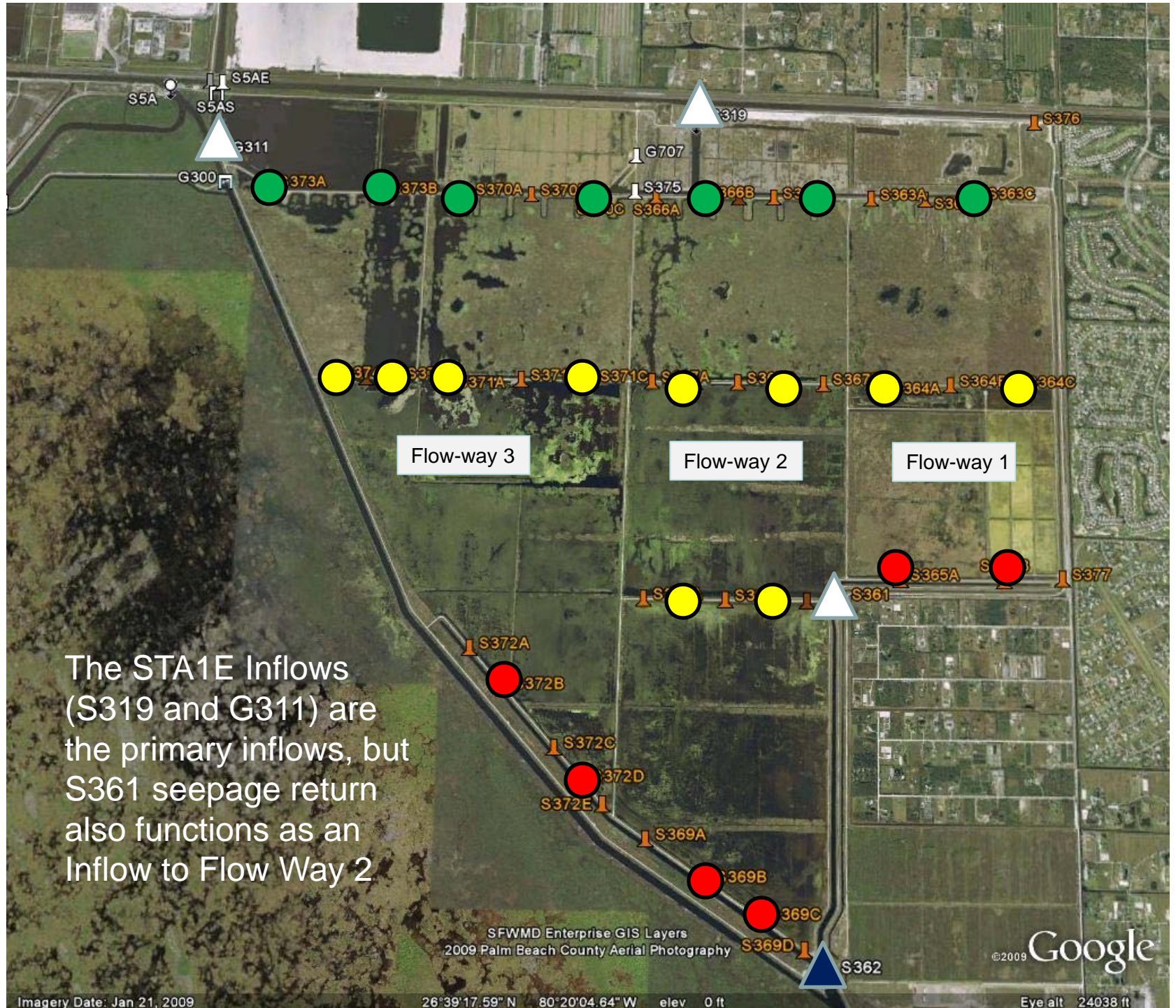
# Current Approach for Monitoring STAs

1. STA Inflows are monitored 
  - ACF TP
  - Grab Weekly TPO4
  - Grab WRF TDP, OPO4, TKN, NOx, NH4, SO4, Cl, Ca, TSS and for STA1E&W Alkalinity
  - Grab Quarterly DOC
2. Representative Flow Way Starts are monitored 
  - Grab BRF TPO4, Ca
3. Representative Flow Way Interiors are monitored 
  - Grab MRF TPO4, TDP, OPO4, Ca
4. Representative Flow Way Ends are monitored 
  - Grab WRF TPO4, TDP, OPO4, Ca
  - Grab Quarterly DOC
5. Representative STA Outflows are monitored 
  - ACF TP
  - Grab Weekly TPO4
  - Grab BRF TDP, OPO4, TKN, NOx, NH4, SO4, Cl, Ca, TSS and for STA1E&W Alkalinity
  - Grab Quarterly DOC

# Current Approach for Monitoring STAs

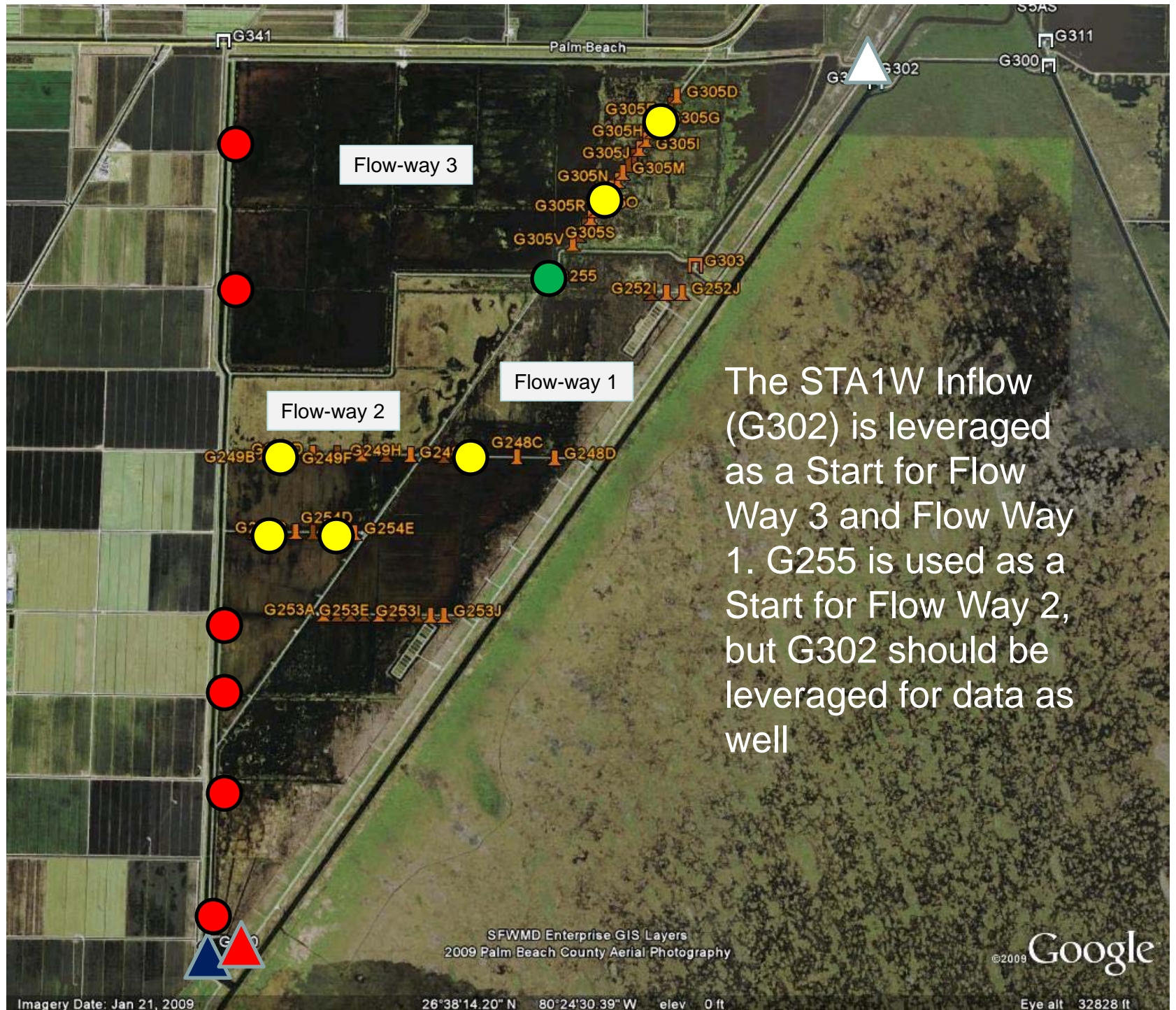
6. Diversion structures are monitored 
  - Grab WRF TPO4
7. If an unused Flow Way is going to be reactivated, the STA Management Team can ask for routine sampling to occur even if triggers have not been met
8. If additional monitoring at a structure or Flow Way is needed, a special request can be made
9. Seepage structures are not monitored
10. If a structure falls under multiple rules or mandates, the condition with the strictest requirements for a parameter will dictate the frequency  

# STA 1E



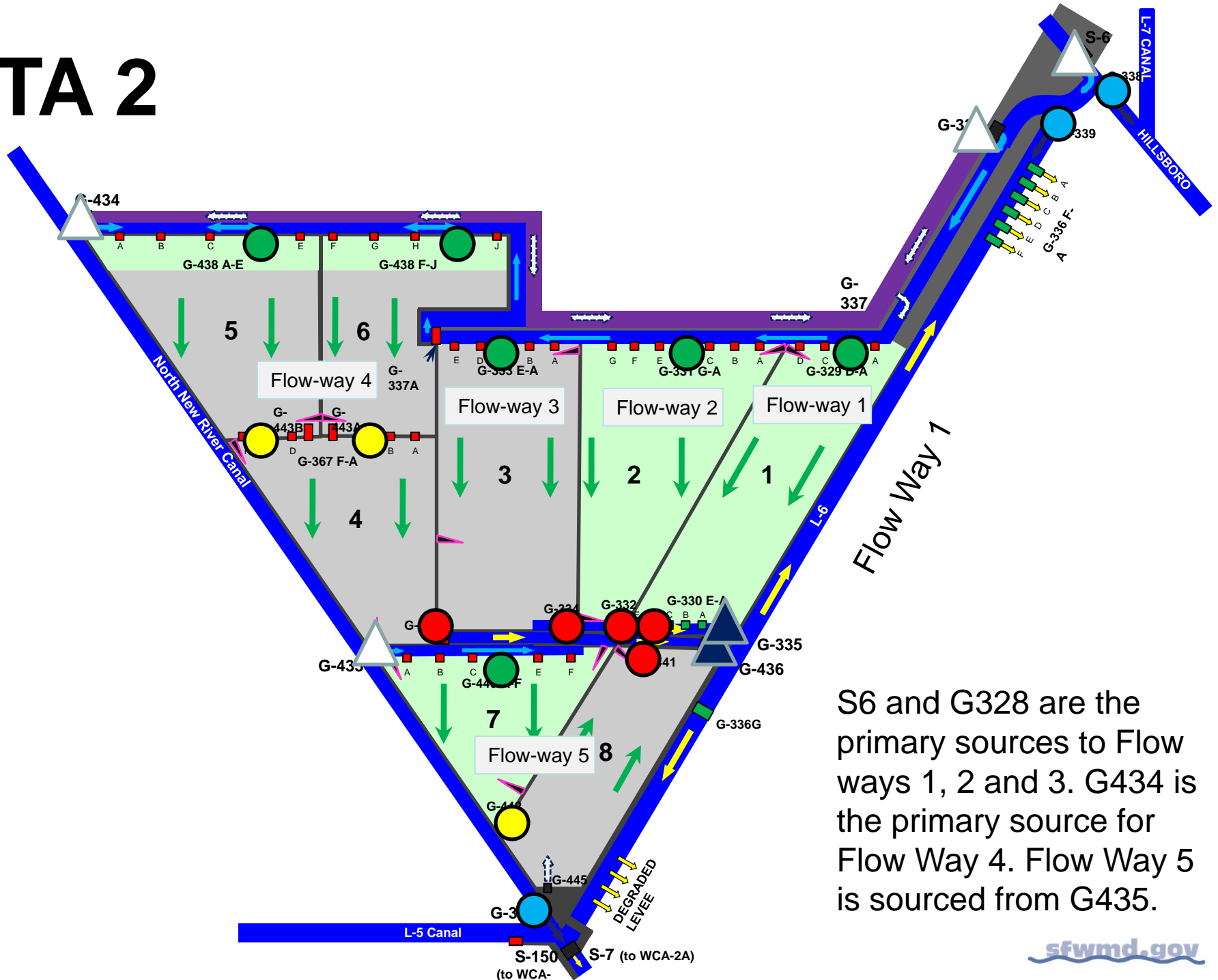
The STA1E Inflows (S319 and G311) are the primary inflows, but S361 seepage return also functions as an Inflow to Flow Way 2

# STA 1W



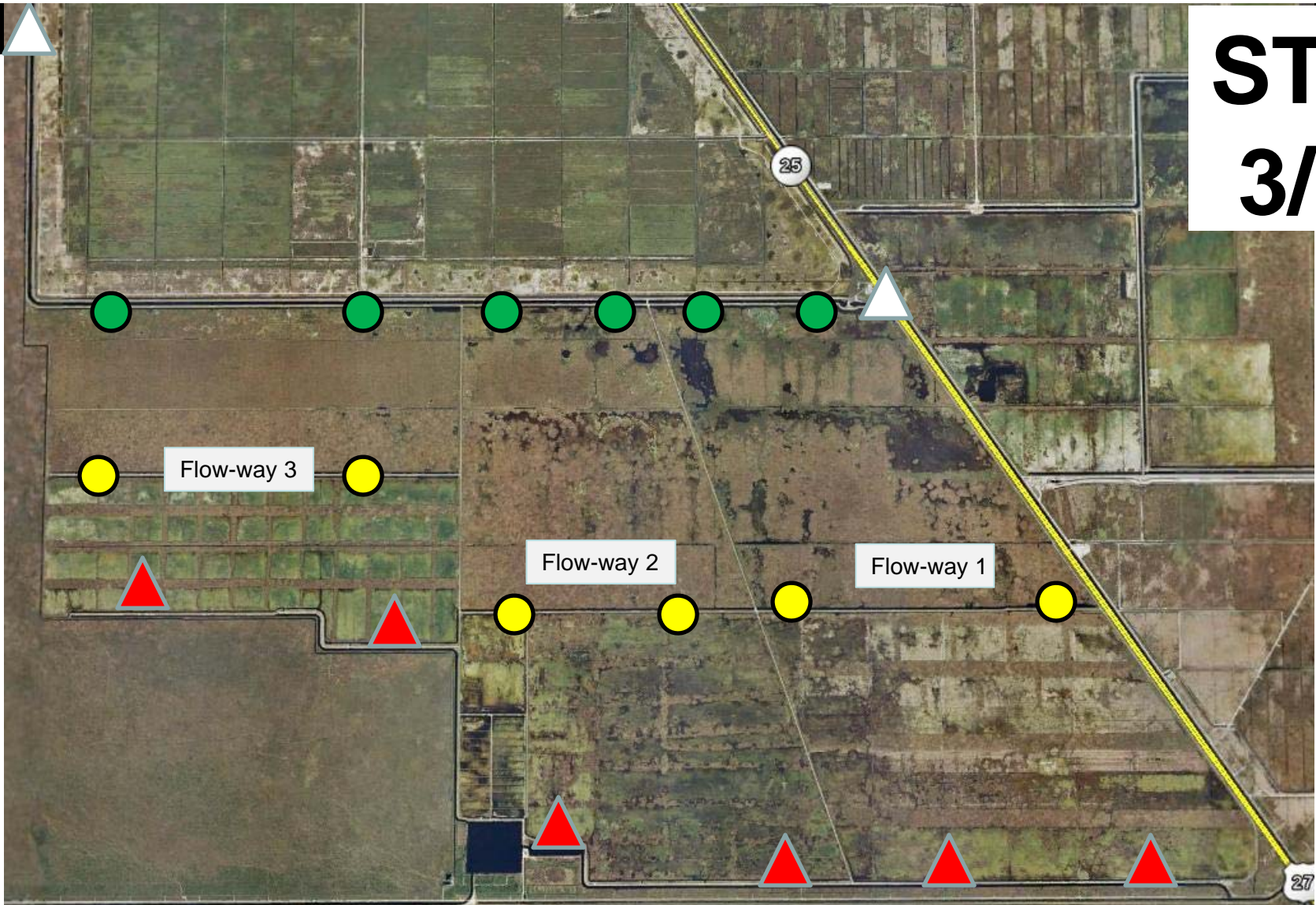


# STA 2



S6 and G328 are the primary sources to Flow ways 1, 2 and 3. G434 is the primary source for Flow Way 4. Flow Way 5 is sourced from G435.

**STA  
3/4**



**All Flow ways sourced from either G370  
or G372**

2011 Palm Beach County Aerial Photography

©2009 Google

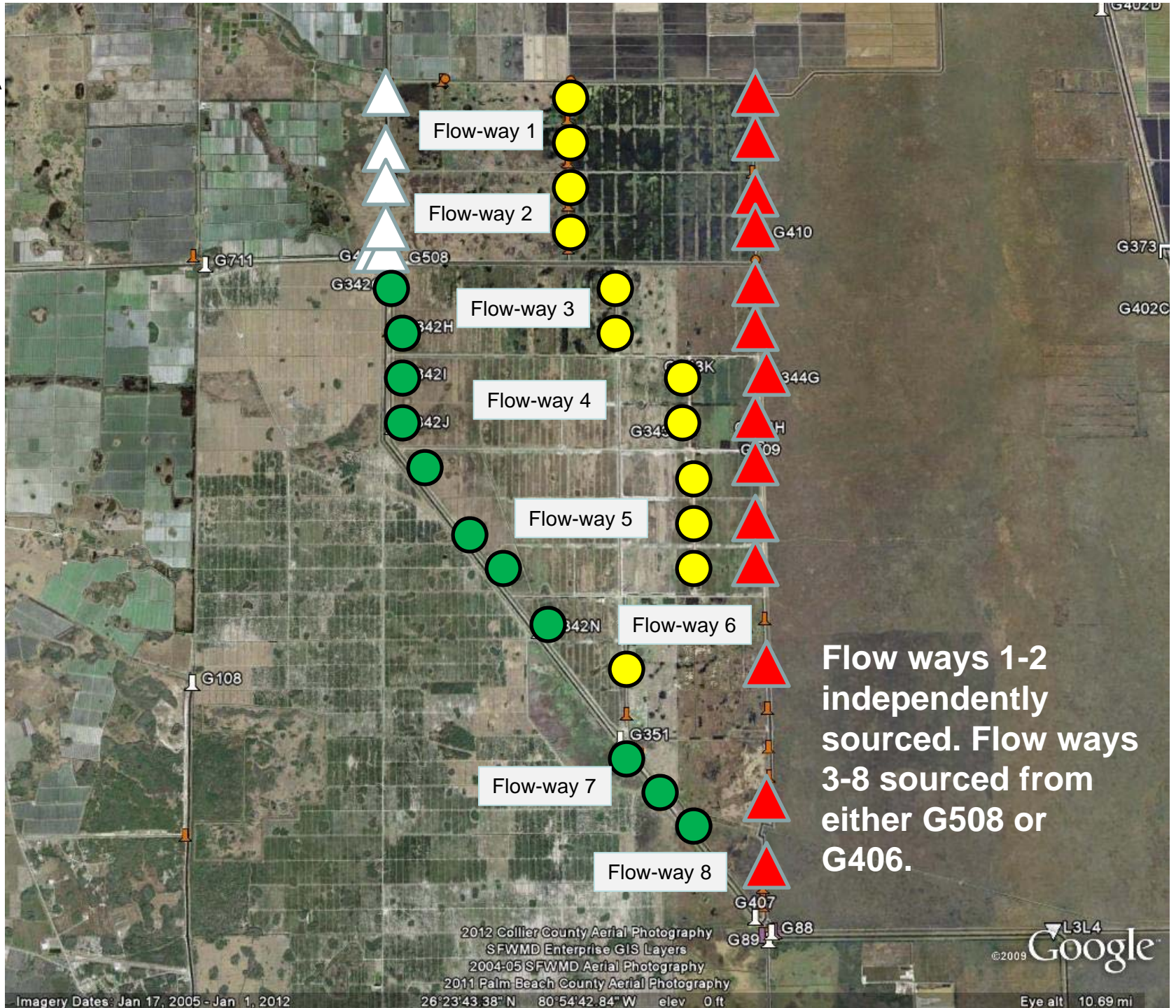
2004-05 SFWMD Aerial Photography

Imagery Dates: Jan 17, 2005 - Nov 23, 2010

26°22'03.64" N 80°36'45.67" W elev 0 ft

Eye alt 43508 ft

# STA 5/6



# Detecting Long-Term Trends

- Operations, vegetation management, episodic loading, and climatic events may have impacts on individual cells
- If those impacts are significant there should be a signal in the Ends or Outflows that can be traced back using structure discharges and monitoring

# Modeling Support

- Key parameters still monitored on a weekly basis at STA Inflows, STA Outflows and flow way Ends, slight reduction at flow way Starts (weekly to biweekly)
  - Data at STA Inflows could be leveraged for long-term modeling

# Monitoring for Research Projects

- Develop guidance to allow for short-term, focused monitoring
  - Can be more frequent at specific locations and with customized parameters
  - Can respond to changes in data or operations from flow ways or cells, and/or research projects
- The prime example of this is the monitoring designed for PSTA cells in STA 3/4

# Supporting Transect Studies

- Transect studies will require P speciation along gradients, and if these studies are implemented, the monitoring plan will be adjusted as necessary
- However, autosamplers can only measure TP, TKN, TOC their use in transect studies is limited
- It is more likely that intensive grab sampling or time dependent autosamplers will be used instead of flow dependent autosamplers, and will be developed under the Science Plan studies, not routine monitoring

# Canal Sediment Release Studies

- Canal mass balance studies are limited to areas upstream of STA Inflows, between Inflows and Starts, or between Ends and Outflows
  - These have at least one intensively monitored member, and one autosampler
- To properly characterize the water quality during such studies, parameters other than TP will be required and the frequency of sampling may need to be altered
  - Time discrete samplers might be preferable over flow composites samplers
  - Sampling regimes will be designed through the Science Plan



# Monitoring Support for Expanded STAs using Ends as Inflows

- The design and integration of expanded treatment areas has not been completed
- Expanded STAs may be linked to existing Ends, but may also be linked directly to existing inflows or even new inflows
  - The existing monitoring program must focus on existing conditions
- Monitoring will be adjusted in response to infrastructure changes as needed

# Monitoring Plan and Research Results

- The current approach supports all the existing mandates, but is not a mandate itself (it can be modified)
- Monitoring can be modified in response to new discoveries, changing priorities and new thinking
- If research suggests that changes in parameters or frequencies are important, the monitoring can be modified
  - This is expected (adaptive management)

# Discussion

